39°07'30"

R80 W. R79

AREA C

and gold resources in quartz-pyrite veins, but most

veins are outside the study area. Minor amounts of

uranium occur in some of the veins at the Josephine

potential for uranium resources is considered low.

dioritic Precambrian rocks, and the reported gold

fissure veins are clearly fault controlled, locally

than 3 ft wide, are locally brecciated, and have a

hematitic alteration. Magnetite, specularite, and

Numerous fire assay analyses indicate gold values of

potential because of the low grade of most veins and

Anomalous radioactivity at the Josephine mines

occurs along a N. 70° W.-striking vein near the Otero

0.04-0.07 oz/ton. In summary, the area of quartz-

pyrite-gold veins has a low to moderate resource

because of evidence that the most important vein

pumping station. The radioactivity is as much as

twice background but the analyzed samples indicate

only 6 ppm equivalent U_3O_8 . Some of the peridotite

porphyry dikes in this area are slightly radioactive

and have been extensively prospected. The peridotite

mine during the 1930's (Vanderwilt, 1947). The

chalcopyrite are present in only minor amounts.

of the Fourmile Creek area are chiefly in granitic to

production was low, about 53 oz from the Little Annie

branched, show numerous pinch-outs, are generally less

pyrite are locally common, but sphalerite, galena, and

The northwest-striking quartz-pyrite-gold veins

mines near the Otero pumping station, but the

Area C has a low to moderate potential for silver

approximately located; dotted where concealed. Ball and bar on downthrown side 25 STRIKE AND DIP OF BEDS

STRIKE AND DIP OF COMPACTION FOLIATION IN ASH-FLOW TUFF

STRIKE AND DIP OF FOLIATION IN PRECAMBRIAN ROCKS

- SYNCLINE

CORRELATION OF MAP UNITS

Td | > Pliocene and Miocene

Upper Cretaceous

} Paleocene

Tv | > Oligocene

Qa | Holocene and Pleistocene QUATERNARY

DESCRIPTION OF MAP UNITS

ALLUVIUM, TERRACE AND FAN DEPOSITS, TALUS AND

DRY UNION FORMATION (PLIOCENE AND MIOCENE)--

RHYOLITIC DIKES (OLIGOCENE?)--Very light-gray

BUFFALO PEAKS ANDESITE AND BADGER CREEK TUFF

dikes of the Fourmile Creek area

RHYOLITE STOCK OF ROUGH AND TUMBLING CREEK

gray dikes of the Granite district

SEDIMENTARY ROCKS, UNDIVIDED (PALEOZOIC)--

and Sawatch Quartzite Undivided

QUARTZ MONZONITE, ADAMELLITE, GRANITE, AND

SAMPLE LOCALITY AND (OR) MINE OR PROSPECT

APPROXIMATE BOUNDARY OF BUFFALO PEAKS WILDERNESS

Geology from reconnaissance mapping by D. C.

Hedlund, 1982

Quadrangle Locations

LOCATION--Referred to in tables 2 and 3.

QUARTZ DIORITE (PROTEROZOIC Y and X)

QUARTZ DIORITE (PROTEROZOIC Y)

rhyolite porphyry

Ordovician)

PROSPECT

Pit

>---

 \succ

Shaft

Adit

QUARTZ VEIN

Trench

(PALEOCENE) -- Very light-gray, biotitic

RHYOLITE DIKES (UPPER CRETACEOUS)--Very light-

Includes Minturn and Belden Formations,

Leadville Limestone, Chaffee Group, Fremont

Dolomite, Harding Sandstone, Manitou Dolomite

(Pennsylvanian, Mississippian, Devonian, and

GRANODIORITE PORPHYRY, UNDIVIDED (PROTEROZOIC

MIGMATITE (PROTEROZOIC X)--Chiefly migmatitic and

sillimanitic biotite gneiss; includes some

lenses of amphibolite and hornblende schist

GLACIAL DEPOSITS (HOLOCENE AND PLEISTOCENE)

Unconsolidated fluviatile deposits of sand,

UNDIVIDED (OLIGOCENE)--Both fine-grained and

porphyritic andesite flows with intercalated

ash-flow tuffs of Badger Creek near the base

silt, and gravel; includes minor volcanic ash

TERTIARY

CRETACEOUS

PALEOZOIC

PROTEROZOIC Y

- PROTEROZOIC X

PROTEROZOIC Y and X

Intrusive Sedimentary

Tri

YXq

EXPLANATION OF RESOURCE POTENTIAL

indicated by stipple pattern

gold and silver in vein deposits

AREA A--Moderate resource potential for silver in

high resource potential at Weston Pass

AREA B--Low to moderate resource potential for

AREA C--Low to moderate resource potential for

gold and silver in vein deposits and low

uranium including a small low-grade uranium

for barite and lead in vein deposits. A

small area along the northeast side of the

identified resource area around the Parkdale

iron pit. Low to moderate resource potential

Middle Fork of Salt Creek has low to moderate

deposits; indicated by diagonal line pattern

resource potential for uranium in veins

AREA D--Low to moderate resource potential for

resource potential for silver in vein

AREAS E AND F--Low resource potential for barite

and lead in vein deposits as defined by

geochemical studies

10 6° 07′ 30″

base-metal deposits; includes small area of

* SAMPLE LOCALITY FOR POTASSIUM-ARGON AGE DETERMINATIONS

STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey and the U.S. Bureau of Mines to survey certain areas on Federal lands to determine their mineral resource potential. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a mineral survey of the Buffalo Peaks Wilderness Study Area in the Pike and San Isabel National Forests, Lake, Park, and Chaffee Counties, Colo. The area was established as a wilderness study area by Public Law 96-560, December 22, 1980.

MINERAL RESOURCE POTENTIAL SUMMARY STATEMENT

and the U.S. Bureau of Mines conducted field

During 1981 and 1982 the U.S. Geological Survey

investigations to evaluate the mineral resource potential of the Buffalo Peaks Wilderness Study Area. The study area encompasses about 57,200 acres (about 89 mi²) of the Pike and San Isabel National Forests in Lake, Park, and Chaffee Counties, Colo. Six separate areas (A-F) are determined to have mineral resource potential. Area A, along the northeast margin of the study area, has a moderate potential for silver resources in base-metal veins and bedded replacement deposits. Within Area A, a small zone near Weston Pass has high potential for silver resources in veins. The northwest part of the study area (Area B) has a low to moderate potential for silver and gold resources in quartz-pyrite veins. Most veins occur outside the study area. Area C is along the southwest margin of the study area and has a low to moderate potential for silver and gold resources in quartz-pyrite veins. Most veins occur outside the study area. In addition, area C has a low potential for uranium resources in veins. Area D has an identified uranium resource and a low to moderate potential for additional uranium resources in uraniferous jasperoids in the Sawatch Quartzite along the southeast margin of the study area. In the rest of area D there is a low to moderate resource potential for lead and barite in fault-controlled deposits. Within area D a small zone along the northeast side of the Middle Fork of Salt Creek has low to moderate resource potential for silver in vein deposits. Anomalous amounts of barium (2,000-10,000 ppm) and lead (30-1,500 ppm) were discovered by geochemical sampling of stream sediments in areas E and F along the east margin of the study area. However, no bedded replacement or vein deposits of barite or galena were observed during geologic mapping and therefore a low to moderate resource potential is assumed for barite and lead in areas E and F. The six mineralized areas are largely related to fault systems and to Laramide intrusive activity. There is little or no indication for oil or gas, or geothermal energy

INTRODUCTION

acres (89 mi²) is within the Mosquito Range and the

Pike and San Isabel National Forests of Colorado. The

The Buffalo Peaks Wilderness Study Area of 57,200

resources in the study area.

noted.

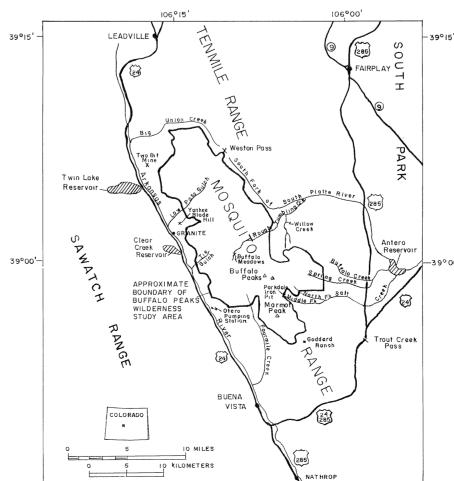
Mosquito Range, which is continuous with the Tenmile Range north of Weston Pass, is a part of the N. 30° W.-striking east flank of the large, completely faulted Sawatch anticline (Tweto, 1975). The anticline has a core of Precambrian igneous and metamorphic rocks and an east flank of eroded Paleozoic strata which dip 25°-30° eastward. Present investigations by the U.S. Geological Survey and the U.S. Bureau of Mines include mapping an area of about 125,000 acres in and around the study area. The U.S. Geological Survey investigations include geologic mapping at a scale of 1:50,000 (Hedlund, in press), an aeromagnetic survey (Hedlund, in press), and a geochemical sampling of rocks, stream sediments, and spring water (Nowlan and Gerstel, in press; Nowlan and others, in press). The U.S. Bureau of Mines has reviewed past and present mining and prospecting activity, and numerous mines and prospects of the study area were examined and sampled by Wood (1983). During the period of this study no actual mining was observed although numerous claim notices and claim stakes (Earth Sciences, Inc., 1980) in the vicinity of Weston Pass and along Union Gulch were

ACK NOWL EDGMENTS

We gratefully acknowledge the assistance of J. C. Hersey of Gunnison, Colo., for providing the mining history and some of the production figures for various mines in the Granite district. We also thank J. V. Dodge of Canon City, Colo., for providing the mining history and reserve estimate for the Bronco-Lady Elk claims.

GEOLOGY

Precambrian rocks comprise a little more than three-fourths of the outcrop area and consist of older Proterozoic migmatite, amphibolite, and granodiorite rocks that are intruded by younger Proterozoic Y granitic rocks. Paleozoic strata, about 8,500 ft thick, comprise the remnant east-dipping limb of the Sawatch anticline and include an extensive section of carbonate and quartzite strata in the lowest 750 ft of the sequence. Laramide intrusions include a biotitic rhyolite stock along the east side of Rough and Tumbling Creek and thin rhyolite dikes of the Granite district. Middle Tertiary flows and ash-flow tuffs of the Buffalo Peaks Andesite are as much as 1,600 ft thick near East Buffalo Peak in the southeast part of the study area.



INDEX MAP SHOWING LOCATION OF THE BUFFALO PEAKS WILDERNESS STUDY AREA

Faults have had an important influence on the localization of mineral deposits within the study area. The silver-bearing base-metal veins of the Weston Pass-Union Gulch districts are along a branched fault system that is coextensive with the large Weston fault. The quartz-pyrite-gold-tourmaline veins of the Granite-Two Bit districts occupy closely spaced eastnortheast-striking faults in migmatite. In area C, along both sides of Fourmile Creek, the quartz-pyritegold veins are coextensive with north-northweststriking faults that show evidence of repeated movement. The uraniferous vuggy jasperoids at and near the Parkdale iron pit are probable hydrothermal

vein and bedded replacement deposits that are localized along fractures and small faults in the Sawatch Quartzite.

GEOCHEMISTRY

Geochemical sampling was done during June and July of 1982 (Nowlan and Gerstel, in press; Nowlan and others, in press). A total of 240 stream-sediment and panned-concentrate samples and 100 water samples were collected and analyzed. The results show that the geochemical patterns for the four areas, A-D, are distinctive and reflect known mineralization in adjacent areas outside the study area. A geochemical gold anomaly in Buffalo Meadows could not be traced to any known gold veins although numerous northnorthwest-striking faults are present in the area. Similarly, the barium and lead anomalies of areas E and F cannot be related to any known mineral deposits. Statistics for analyses of stream-sediment and panned-concentrate samples are shown in table 1. Selected geochemical analyses are shown in table 2.

GEOPHYSICS

The aeromagnetic map (Hedlund, in press) shows the magnetic expression of some of the major rock types in the study area but does not indicate the presence of any concealed mineralized areas. The Laramide stock of Rough and Tumbling Creek has very little magnetic expression and skarn deposits appear to be absent.

MINING DISTRICTS AND MINERALIZED AREAS

Six areas having mineral resource potential (A-F) have been delineated for the Buffalo Peaks Wilderness Study Area. These areas do not necessarily correspond to specific mining districts but do encompass areas of similar mineralization. The study area is within, or adjacent to parts of the following mining districts: Weston Pass, Granite, Buffalo Peaks, Fourmile, Two Bit. and Union Gulch (Henderson, 1926). There are no active mines within the study area, but about 2,000 acres of the Buffalo Peaks Wilderness Study Area are covered by mining claims (Wood, 1983). The various mineral deposits within the described areas are discussed in order from A to F and not necessarily in order of decreasing potential (see table 3). All of these areas are along the periphery of the study area boundary with most of the discovered mineral resources outside the study area. The six mineralized areas are largely related to fault systems and to Laramide

intrusive activity. Area A extends along the Weston fault zone and Manitou Dolomite. Area B encompasses the Granite-Two Bit districts that are within a Precambrian migmatite gold-silver quartz-pyrite veins of area B strike eastnortheast and locally occur in swarms, as on Yankee Blade Hill. Area C is also characterized by quartzpyrite-gold veins but most deposits are small and are Precambrian granite. Both uranium and silver-bearing uraniferous jasperoids at the head of the Middle Fork resource of low-grade uranium. Numerous small silverbearing prospects occur along faults on the east side geochemical survey that discovered anomalous lead and barium values in analyzed stream-panned concentrates.

The six areas of mineral resource potential (A-F) are discussed in greater detail in the following sections. Evidence of mineralization is provided by the numerous mine workings and prospects along fault and vein systems, and by the anomalous metal values discovered in analyzed rock and vein samples and in stream-sediment panned concentrates. The six mineralized areas are largely related to fault systems and to Laramide rhyolitic intrusive activity.

resources in base-metal deposits. A very small part of this area has high potential for silver resources, especially at Weston Pass where silver-bearing veins of the Gates mine extend into the study area. The rocks are chiefly Paleozoic carbonate strata that are displaced by numerous northwest-striking faults coextensive with the Weston fault system. Most of the past silver production was from the Ruby-Cincinnati, Gates, and Collin Campbell mines in the vicinity of Weston Pass; the production figures are not known but may have been as much as 125,000 oz of silver. The veins are chiefly along silicified fractures and breccia zones in the Leadville Limestone, and in places the veins grade outward into bedded replacement deposits. The richest ores came from oxidized ore bodies in a zone of supergene enrichment, generally at depths of less than 300 ft (Behre, 1932).

In summary, the northwest-striking faults of the Weston system are favorable sites for the occurrence of silver-bearing base-metal resources, especially where the faults displace carbonate strata. The metal values of the protores are chiefly in zinc, lead, and silver with anomalous amounts of arsenic as much as 1,500 ppm, and cadmium as much as 70 ppm.

Area B has a low to moderate potential for gold and silver resources in quartz-pyrite veins, and is largely outside the study area. The rocks are chiefly highly foliated migmatitic gneisses that are cut by east-northeast-striking faults that are locally coextensive with rhyolite dikes (map unit Kr). Production of gold from the Granite district is estimated at 65,000-97,000 oz, chiefly from about 1862 to 1878. The mines of the Two Bit district have been chiefly exploited for silver, but the production is

The quartz-pyrite-gold veins of the Granite district are characterized by: 1. intensive silicic and chloritic wallrock

2. a relatively low base-metal content, a gold to silver ratio of about 2.5:1,

5. the presence of tourmaline in many veins, and 6. a local, spatial association with rhyolite dikes with a potassium-argon age of 65.3±2.4 m.y. (R. F. Marvin and others, written commun.,

into the study area at depth, especially in areas of migmatite outcrop. However, surface geologic studies indicate that this is unlikely since alteration haloes are generally absent.

includes the numerous silver-bearing base-metal deposits that are localized along silicified fault breccias in the Paleozoic Leadville Limestone and belt intruded by younger Precambrian granite. The localized along north-northwest-striking faults in base-metal deposits occur in area D. The vuggy of Salt Creek contain as much as 288 ppm equivalent uranium and can be classified as an identified of the Middle Fork of Salt Creek, also in area D. Areas E and F are delineated on the basis of a

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

Area A has a moderate potential for silver

Though the veins were extensively exploited in the Weston Pass district, other veins to the northwest near Union Gulch and to the southeast are relatively unexplored. The prospects in these peripheral areas are also fault controlled, the sulfides localized along silicified shatter zones, in breccias, and along vuggy, dolomitic, and "zebra-striped" carbonate strata. However, the silver values from a few of the sampled prospects are relatively low, about 0.2-0.5 oz/ton.

not known.

gold values that range from 0.2-1.7 oz/ton and silver contents of 0.1-0.8 oz/ton,

Many of the quartz-pyrite-gold veins could extend

dikes deserve a second review for the presence of platinoid metals.

silver in vein deposits.

systems are outside the study area.

The uranium deposit in the Parkdale iron pit area is a low-grade uranium resource and the rest of area D has a low to moderate potential for uranium resources in vuggy, uraniferous jasperoids, and barite and lead in vein or bedded replacement deposits. A small area along the northeast side of the Middle Fork of Salt Creek has low to moderate resource potential for

The uraniferous jasperoid at the Parkdale iron pit and vicinity has received the most study and is along the study area boundary at the head of the Middle Fork of Salt Creek. At least 11 other small radioactive jasperoids are known in this area and occur in or near the top of the Sawatch Quartzite that forms a N. 40° W.-striking ridge. In the mid 1950's about 52 tons of jasperoid that averaged 0.12 percent $\rm U_3O_8$ and 0.20 percent $\rm V_2O_5$ was shipped to the uranium mill in Rifle, Colo. (Nelson-Moore and others, 1978, p. 365). These deposits were evaluated in the mid 1970's by J. V. Dodge and associates by trenching, geophysical and geochemical studies, and by some drilling. An estimated resource of about 4,000 tons per vertical foot of uraniferous jasperoid averaging 0.04 percent U_3O_8 and 0.20 percent V_2O_5 is identified for an area of about 1,200 by 40 ft (J. V. Dodge, written commun., 1982). Only about 3-4 ft of jasperoid is exposed in the Parkdale iron pit and in nearby trenches, but according to J. V. Dodge (oral commun., 1982) a drilling program conducted by Noranda Exploration, Inc., indicated that the uraniferous jasperoid is as much as 45 ft thick at the Parkdale iron pit. Other estimates place the average thickness at 60 ft in an area 300 by 1,500 ft (J. V. Dodge, oral commun., 1983). No specific uranium mineral was identified in this study; fission-track maps show that the uranium is dispersed as an amorphous colloid

jasperoid indicate the following values for equivalent U₃O₈ in parts per million: 36, 135, 241, 243, 287, and 288. Twelve fire assays for gold and silver indicate less than 0.005 oz of gold per ton and most silver values range from 0.2 to 0.3 oz/ton. Spectrographic analyses of the uraniferous jasperoid indicate the presence of 5,000 ppm manganese, 150 ppm vanadium, 2,000-3,000 ppm zinc, 30-50 ppm lead, 5-55 ppm copper, and 10-13 ppm thorium. Some of the jasperoid has as much as 40 percent iron, which would be a suitable grade for a taconite deposit if it was closer to a processing facility or if larger volumes of jasperoid were present.

throughout the jasper. Analyzed samples of the

Numerous small silver vein prospects (locality 4) are along a northwest-striking fault in the Belden Formation along the northeast side of the Middle Fork of Salt Creek. These deposits have been extensively sampled (Wood, 1983), and the gold content of the veins is negligible, less than 0.005 oz/ton; the silver content ranges from 0.1 to 0.5 oz/ton. This part of area D has a low to moderate resource potential for silver in vein deposits.

A geochemical survey near the head of the North Fork of Salt Creek has indicated relatively high barium (5,000; 10,000 ppm) and lead (1,500 ppm) anomalies in stream sediments. These anomalies appear to be close to the northwest-striking fault along the northeast side of the Middle Fork of Salt Creek. A low to moderate potential for barite and lead resources in vein or bedded replacement deposits

exists in this area.

AREAS E AND F

A geochemical survey has delineated two areas, E and F, of anomalous barium and lead values in panned stream concentrates. The source areas of barite and lead were not discovered during this study, and therefore both areas are considered to have low to moderate resource potential for barite and lead. Area E, in the vicinity of Spring Creek, yielded barium values of 2,000 and 10,000 ppm in analyzed panned concentrates (Nowlan and Gerstel, in press). Other metals detected were 30 ppm lead, 10 ppm copper, and as much as 500 ppm zinc. In area F, similarly high barium values (15,000

ppm) were obtained from panned concentrates along Willow Creek. Some of these concentrates are also high in lead (1,500 ppm). This area may be coextensive with area A and may represent a supra-ore halo of epithermal-type mineralization that was synchronous with the ore deposition in the Weston Pass district.

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R. H. Wood, II, U. S. Bureau of Mines 1983

MINERAL RESOURCE POTENTIAL MAP OF THE BUFFALO PEAKS WILDERNESS STUDY AREA, LAKE, PARK, AND CHAFFEE COUNTIES, COLORADO

D. C. Hedlund and G. A. Nowlan, U. S. Geological Survey

APPROXIMATE MEAN DECLINATION, 1955

500 0 500 1000 1500 2000 2500 Meters

CONTOUR INTERVAL 40 AND 80 FEET

15,000 Feet

Base from U. S. Geological Survey, 1:24,000

Granite, 1967; South Peak, 1961; 1:62,500

Mount Sherman, 1961; Jones Hill, 1961;

Buena Vista, 1955